Explore-28 QUICKSTART GUIDE

Congratulations on purchasing an Explore-28 module. The Explore-28 is a small PCB carrying all the components necessary to get started using Micromite Basic:

- PIC32MX170 processor (MX170) containing the MMbasic interpreter and full-screen editor. MMbasic is a Microsoft BASIC compatible implementation of the BASIC programming language with floating point, integer and string variables, arrays, long variable names, and support for a variety of peripherals. With up to 52k of RAM available for variables, and nearly 60k of flash memory space for the user's basic program, it is comparable to a 1980's Commodore-64 home computer (sans graphics and sound), but running BASIC code close to 50 times faster.

- PIC16F1455 pre-programmed with open source firmware to provide the functions of USB to serial bridge (so you can talk to MMbasic via a USB port on your PC using a terminal emulator such as Teraterm), along with an integrated ICSP programmer to allow updating the MMbasic interpreter inside the MX170 without need for any external hardware.

- MCP1703 3.3 volt LDO voltage regulator that can accept up to 16 volts input and deliver 250mA output. The MX170 itself draws around 26mA when running at the default CPU clock speed of 40MHz, and only 5mA when throttled back to 5MHz.

- 19 I/O lines are available to the user program, providing analog inputs, digital I/O, I^2C, 1-wire, SPI, PWM, servo control, IR remote (Tx and Rx), counting and frequency measurement, and TTL-level RS232. The Explore-28 has the same footprint as an Arduino NANO (30-pin, 0.6" wide DIP), and can be used with NANO breakout boards. 27/28 pins map to their equivalent pins on a 28-pin SDIP MX170 Micromite (pin 20 is omitted), while the remaining 2 pins output USB 5v or can be fed with up to 16 volts if operating standalone (USB not connected).

Micromite Basic is copyright by Geoff Graham. The compiled object code for the Micromite is free software that can be used or redistributed, unmodified, without restriction. The latest object code is available at http://geoffg.net/micromite.html

The 1455 firmware is open source software, written by Peter Mather. It has been built on the M-Stack USB stack, and uses the DS30 serial bootloader. The ICSP portion of the firmware was developed from the 'ascii ICSP' specification and arduino C source code created by Robert Rozée.

Getting Started:

The Explore-28 module is a fully self-contained tiny computer, requiring just a mini-USB cable to connect it to a USB port on your desktop or laptop computer. A VT-100 compatible terminal emulator such as Teraterm can then be used to talk to the module, enter BASIC programs, and view output.

By default, the MMbasic console communicates at 38400 baud, 8 data bits, 1 stop bit, no parity or flow control. Once these parameters have been set in your terminal emulator, you are ready to go. In Teraterm, press <alt-B> to reset the Explore-28 and you should see the MMbasic sign on message:

```
Micromite MKII MMBasic Ver 5.03.02
Copyright 2011-2017 Geoff Graham
>
```

You are now sitting at the command prompt, where you can type in commands that will be processed immediately. For instance:

```
> ? 22/7
 3.14286
>
```

"**?**" is shorthand for "**print**", and the result of dividing 22 by 7 (3.14286) is printed out immediately, after which you are returned to the command prompt.

The full-screen editor is launched by typing "**edit**". Here you can type in BASIC programs, and when finished press <F2> to save and run. The Micromite User Manual contains full details of programming in MMbasic.

Updating the MMbasic Interpreter:

Periodic updates to MMbasic are released by the author, Geoff Graham. These may contain new functionality and/or bug fixes. MMbasic is an ongoing project that is continuously being improved and refined. The latest MMbasic interpreter and user manual can always be downloaded from http://geoffg.net/micromite.html

The Explore-28 module has an onboard ICSP programmer to allow uploading new versions of MMbasic using a program called pic32prog. The latest release of pic32prog can be downloaded from here:

https://github.com/sergev/pic32prog
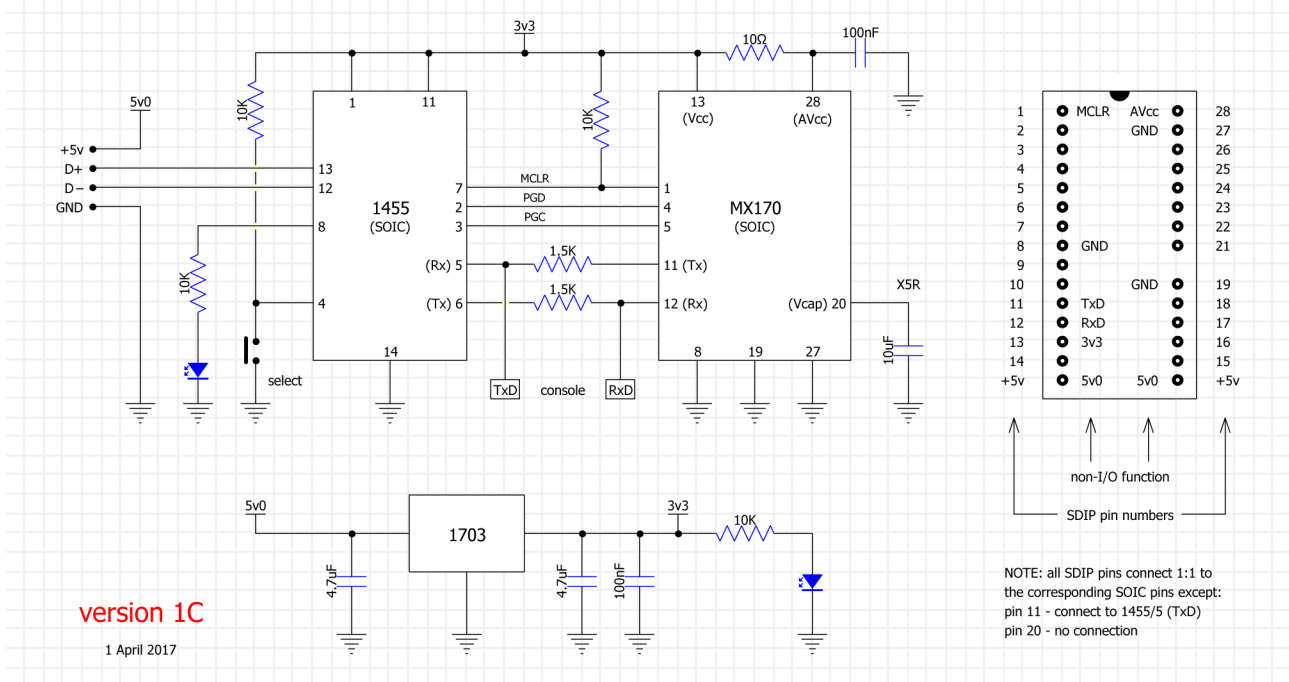https://github.com/sergev/pic32prog/blob/master/pic32prog.exe?raw=true

(direct link to Win32 executable. Mac OS X and Linux versions are also available)

To update MMbasic using pic32prog, briefly press the **SELECT** button on the Explore-28 module to enter ICSP (MX170 firmware update) mode, then type the following command into a console/cmd window on your PC:

```
pic32prog -d ascii:com5 filename.hex
```

where **com5** is the serial port assigned to the Explore-28 module, and **filename.hex** is the firmware file to be uploaded.

Hardware Notes:

Schematic diagram labels:

3v3 · 10Ω · 100nF

5v0 · 10K · 1 · 11 · 10K · 13 (Vcc) · 28 (AVcc)

+5v · D+ · D− · GND

10K · select

1455 (SOIC) · 13 · 12 · 8 · 4 · 7 PGD · 2 PGC · 3 · MCLR · 14

MX170 (SOIC) · 1 · 4 · 5 · X5R · 10uF · (Vcap) 20

(Rx) 5 · 1,5K · 11 (Tx) · (Tx) 6 · 1,5K · 12 (Rx) · 8 · 19 · 27

TxD · console · RxD

version 1C

1 April 2017

5v0 · 4.7uF · 1703 · 3v3 · 4.7uF · 100nF · 10K · 3v3

SDIP pin table:

1	MCLR	AVcc	28
2		GND	27
3			26
4			25
5			24
6			23
7			22
8	GND		21
9			
10		GND	19
11	TxD		18
12	RxD		17
13	3v3		16
14			15
+5v	5v0	5v0	+5v

non-I/O function

SDIP pin numbers

NOTE: all SDIP pins connect 1:1 to
the corresponding SOIC pins except:
pin 11 - connect to 1455/5 (TxD)
pin 20 - no connection

The Explore-28 module contains two LEDs and a **SELECT** button. While one of the LEDs is a power indicator that is permanently lit, the other (mode) LED indicates several different things, depending upon the mode that the 1455 is in.

If a USB cable is connected between the Explore-28 and a PC, and once communications have been established, the mode LED will normally flash whenever a character is sent or received by the Explore-28 module. If the **SELECT** button has been briefly pressed (to enter ICSP mode) the mode LED will be permanently lit until ICSP mode is exited.

The **SELECT** button performs the following functions:
1. when in serial mode, a brief press will place the 1455 into ICSP mode. The mode LED will light and remain lit while in ICSP mode.
2. if in ICSP mode, a long press (2 seconds) will extinguish the mode LED and return the 1455 to serial mode.
3. while in serial mode, a long press (2 seconds) will briefly flash the mode LED and upon release of the **SELECT** button the 1455 will reset the MX170.

The Explore-28 module can be powered either via the USB connector (in which case the 5 volt USB power is available on the two +5v pins), or, when operating standalone, by feeding between 4 and 16 volts <u>into</u> one of the +5v pins. The USB connector must <u>not</u> be connected to anything if feeding power into one of the +5v pins.

When operating on external power fed into one of the +5v pins, the Explore-28 module will draw approximately 32mA while running at the default CPU clock speed of 40MHz, and 15mA while running at 5MHz. The 1455 contributes around 10mA of this current consumption. Note that given the 1455 draws around 10mA at all times, there is little point using the "**CPU sleep**" command in any programs running on the Explore-28.

Pins 11 (TxD) and 12 (RxD) may both act as receive or transmit data pins. Normally TxD can be treated as an output, used to 'snoop' serial data coming out of the MX170. Similarly, RxD can be used to 'snoop' serial data coming from the host computer (via USB). However, because of the 1k5 series resistors present, if data is driven into the TxD pin, it will be seen by the host computer (overriding data from the MX170), while data driven into RxD will be seen by the MX170 (overriding data from the host computer).

Pins 4 and 5 are used while uploading new firmware to the MX170 when the 1455 is in ICSP mode. For this to work correctly, it may be necessary to disconnect any external circuitry from these pins when uploading new firmware to the MX170.

Software Notes:

Windows XP and some installations of Windows 7 may require driver configuration files to be installed before the Explore-28 is recognised. The 1455 firmware uses a generic USB serial device ID (VID:04D8, PID:000A) from Microchip Technology Inc, with a complete driver package available for download from:
http://ww1.microchip.com/downloads/en/DeviceDoc/MCP2221 Windows Driver 2014-10-09.zip

No driver configuration files should be required for Windows 8 or later, Linux, or osX. When tested under Linux Mint the Explore-28 appeared as /dev/ttyACM0 and could be talked to with the Minicom VT-100 terminal emulator.

Robert Rozée, 11-May-2017